

Power Conversion Distribution System
Using a Resonant High-Frequency AC Link.

DAA/LENKS

NAG 3-492

Authors:

Pradeep K. Sood and Thomas A. Lipo

Department of Electrical and Computer Engineering

University of Wisconsin - Madison

1415 Johnson Drive

Madison, Wis. 53706. Tel. (608) 262 - 0727

W4560409

Summary:

Static power conversion systems based on a resonant high-frequency (HF) link offers a significant reduction in the size and weight of the equipment over that achieved with conventional approaches, especially when multiple sources and loads are to be integrated. A faster system response and absence of audible noise are the other principal characteristics of such systems. This paper proposes a new conversion configuration based on a HF link which is suitable for applications requiring distributed power, Fig. 1

The single-phase resonant link, which operates at a fixed frequency above the audible range, performs the dual function of power distribution and temporary energy storage. Component converters are proposed that can operate efficiently from the high frequency in order to interface various sources/loads to the link. A common characteristic of these converters is that all switching instances are restricted to the zero crossing points of the link voltage. This prevents the switching losses from becoming prohibitively large, as they would if conventional techniques of phase-angle control for ac input and PWM for dc input are used at these elevated frequencies. In operation with restricted switching, therefore, the low-frequency signals are synthesized by using half-cycles of the HF voltage as the basic unit of synthesis. A process of pulse-density modulation (PDM)

(NASA-CR-176804) POWER CONVERSION
DISTRIBUTION SYSTEM USING A RESONANT
HIGH-FREQUENCY AC LINK (Wisconsin Univ.)
6 p HC A02/MF A01

N86-25694

CSCL 10B

Unclas

G3/33 43579

is used to control the amplitude of the fundamental component of the synthesized signal in accordance with a reference signal. In this manner, fixed or variable amplitude dc and fixed or variable frequency ac signals (current or voltage) of single- and three-phase type can be synthesized (Fig. 2) from the fixed frequency, single-phase ac voltage of the link. In spite of the restriction on the switching instances, it is shown that the harmonic distortion in the signals synthesized by the PDM converters remains low because of the large frequency differential that will typically exist in a HF link system.

Computer models of the individual components of the proposed system have been developed to obtain better understanding of their operation and to study the overall system behavior. A laboratory breadboard will be used to experimentally verify the validity of the computer simulations. The data from the breadboard will also be used to project efficiency and the economic feasibility of the proposed system.

This work has been sponsored by the NASA Lewis Research Center. It constitutes part of an ongoing feasibility study being conducted by NASA on a 20 kHz link space power conversion system.

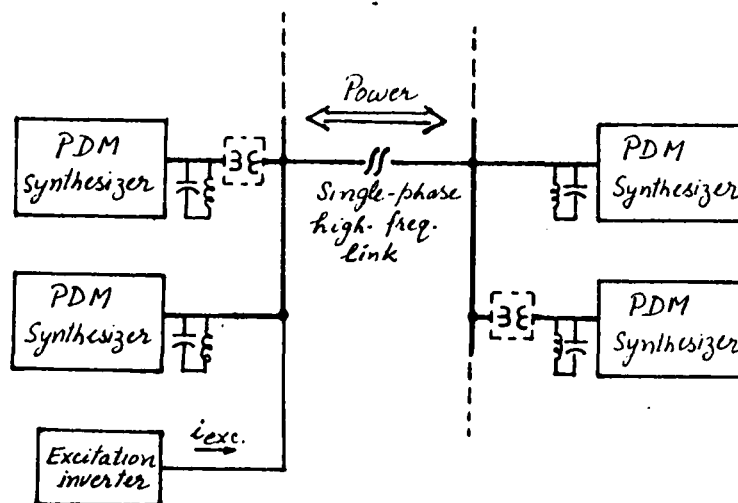


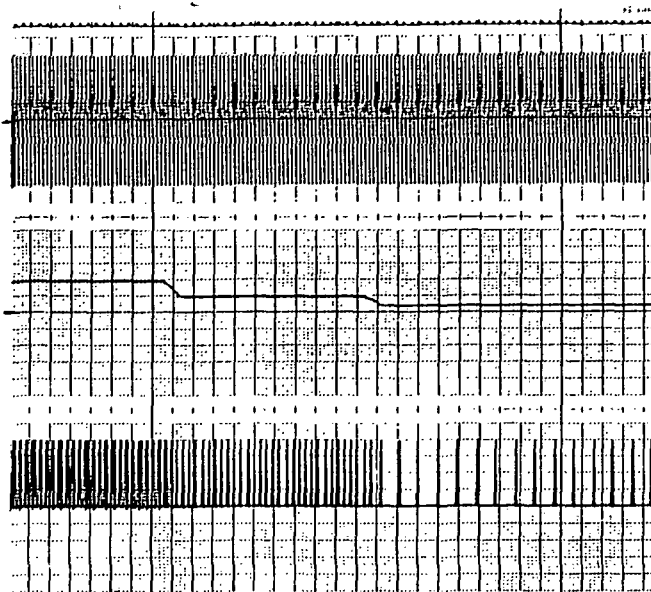
Fig. 1 Proposed HF-link based static power conversion system.

ORIGINAL PAGE IS
OF POOR QUALITY

High freq.
link voltage

Reference
signal

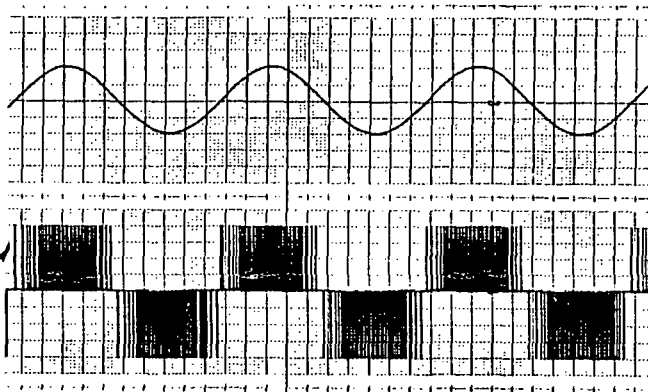
PDM
synthesized
voltage



(a)

Reference
signal

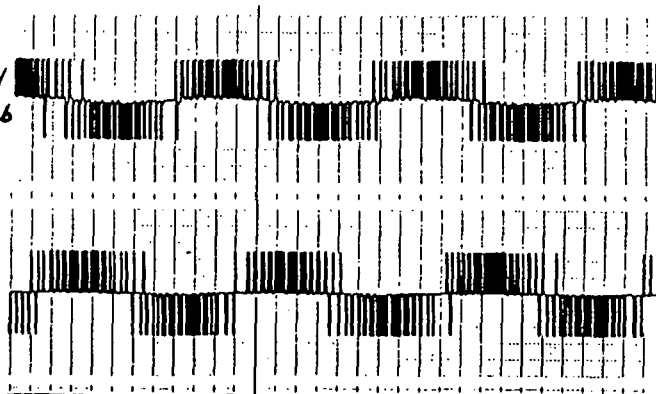
PDM synthesized
voltage



(b)

PDM synthesized
voltage, V_{ab}

PDM synth.
voltage, V_{bc}



(c)

Fig. 2 Pulse-density-modulated (PDM) synthesis of dc and ac voltages. (a) dc. (b) Single-phase ac. (c) Three-phase ac.